Confidential

File No. NCA653864-028

Issue Date: 2016/6/10

LITHIUM ION BATTERY SPECIFICATION

BATTERY CLASSIFICATION	LITHIUM ION BATTERY
PRODUCT CODE	BJ-F900009AA
CLIENT	

Client Agreement:

Signature: _____

Name in Block Letters: _____

Date: _____

* If there is no reply within 30 days following delivery, this document shall be presumed to be valid.

Rechargeable Battery Business Division,
SANYO Electric Co., Ltd.
Automotive & Industrial Systems Company
of Panasonic Group
Battery Application Engineering Department

Dft.	Y. Kagayama
Chk.	T. Saito
Chk.	T. Kuji
App.	M. Nakanishi

Confidential

Table of Contents

Confidential

Title	Lithium Ion Battery Specification (Prismatic Type)	Page	1/14

1 Revision History

No.	Date	Class	Description		
(a)	2016/5/10	—	Issue	Dft.	Kageyama
				Chk.	Saito
				Chk.	Kobayashi
				App.	Nakanishi
(b)	2016/6/10	R	・ Added insulation ring and changed dimension in battery pack (finish goods) ・ Revised 5.11 Weight(Max.) by above specification change	Dft.	Kageyama
				Chk.	Saito
				Chk.	Kobayashi
				App.	Nakanishi
				Dft.	
				Chk.	
				Chk.	
				App.	
				Dft.	
				Chk.	
				Chk.	
				App.	
				Dft.	
				Chk.	
				Chk.	
				App.	

* Legend: A for Added, D for Deleted, R for Revised

File No.	NCA653864-028	Rechargeable Battery Business Division, SANYO Electric Co., Ltd.

2 Safety Instructions

The battery contains flammable materials such as organic solvents. Mishandling the battery may cause fire, smoke, or an explosion and the battery's functionality will be seriously damaged. Protection circuitry must be designed into the application device to protect the battery. Additionally, SANYO highly recommends adding these instructions to the owner's manual. Please read and check the following prohibited actions.

Danger

(1) Immersion

Do not immerse the battery in liquid such as water, beverages, or other fluids.

Exposure to liquid may damage the battery or the battery pack (including protection circuit). As a result, the battery may generate heat, smoke, catch fire, or explode.

(2) High Temperature

Do not use or place the battery near an open flame, heater or high temperature (above 80°C).

Subjecting the battery to high temperature may damage the polyolefin separator and can cause an internal short circuit. This may cause the battery to generate heat, smoke, catch fire, or explode.

(3) Chargers and Charge Conditions

Do not use unauthorized chargers.

Only charge the battery within specified conditions (e.g., temperature range, voltage, and current). Use of an unauthorized charger could cause the battery to generate heat, smoke, catch fire, or explode.

(4) Reverse Polarity

Do not attach or insert battery with polarity reversed.

A battery has polarity. If the battery does not easily fit into the charger or device, check the battery's orientation. Do not force the battery into the battery compartment. If attached to the device with reversed polarity, the battery may generate heat, smoke, catch fire, or explode.

(5) Direct Connection

Do not connect the battery to an AC outlet or DC automotive plug.

The battery requires a specific charger. If the battery is connected directly to a power outlet, the battery may generate heat, smoke, catch fire, or explode.

(6) Use in Other Equipment

Do not use the battery in equipment for which it was not intended.

If the battery is used in unapproved applications or systems, the battery may become damaged and generate heat, smoke, catch fire, or explode.

(7) Incineration and Heat

Keep the battery away from heat and fire.

Heat will damage the battery and may cause it to generate heat, smoke, catch fire, or explode.

(8) Short-Circuit

Do not apply a short-circuit.

Do not connect the positive (+) and negative (-) terminals with a conductive material. Do not carry or store the battery with any metal objects. If the battery is shorted, the shorting item may overheat and the battery may generate heat, smoke, catch fire, or explode.

(9) Impact

Avoid excessive impact to the battery.

Impact beyond specification may damage the battery. This may cause the battery to leak, generate heat, smoke, catch fire, or explode.

(10) Penetration

Do not penetrate the battery with a nail or strike with a hammer.

If subjected to a hard strike or penetrated by an object, the battery may be damaged or destroyed, thereby causing an internal short-circuit. This may cause the battery to generate heat, smoke, catch fire, or explode.

(11) Soldering

Do not directly solder to the battery.

Soldering directly to the battery could melt the separator or damage the gas release vent or other safety mechanisms. This may cause the battery to generate heat, smoke, catch fire, or explode.

(12) Disassembly

Do not disassemble the battery.

Disassembly or modification of the battery may damage the protection circuit. This may cause the battery to generate heat, smoke, catch fire, or explode.

(13) Charge near High Temperatures

Do not charge the battery near high temperature.

If the battery is charged while exposed to high temperature, the battery's protection circuit may activate and prevent charging, or fail and cause the battery to generate heat, smoke, catch fire, or explode.

Warning

(1) Ingestion

Keep away from small children.

Keep the battery away from small children. If the battery or any of its component parts is swallowed, seek medical attention immediately.

(2) Storage

Do not place the battery in or near a microwave or other cooking appliances.

If subjected to heat or electromagnetic radiation, the battery may leak, generate heat, smoke, catch fire, or explode.

(3) Mixed Use

Do not mix with other batteries.

The battery should not be used with other batteries having a different capacity, chemistry, or manufacturer. Doing so could cause the battery to generate heat, smoke, catch fire, or explode.

(4) Rust, Discoloration and Deformities

Do not use abnormal batteries.

Immediately stop using the battery if there are noticeable abnormalities, such as smell, heat, discoloration, or deformity. The battery may be defective and could generate heat, smoke, catch fire, or explode with continued use.

(5) Charging Time

Stop charging if the charging process cannot be finished.

If the battery can not finish the charging process within the specified time, halt the charging process.The battery may generate heat, smoke, catch fire, or explode.

(6) Leakage ①

Do not use a leaking battery near open flame.

If the battery or liquid leaking from the battery has an irritating odor, the battery should be kept away from any open flame. If exposed to an open flame, the battery could ignite and explode.

(7) Leakage ②

Do not touch a leaking battery.

If liquid leaking from the battery gets into your eyes, immediately flush your eyes with clean water and seek medical attention. If left untreated, it will cause significant eye damage.

(8) Transport

Pack the battery securely for transport.

To prevent short-circuit or damage during transport, securely pack the battery in a case or carton.

Caution

(1) Exposure to Direct Sunlight

Do not use or leave the battery in a location exposed to excessive heat, such as in direct sunlight or in a car. Doing so could cause the battery to generate heat, smoke, catch fire, or explode. It may also cause the battery's performance and life to deteriorate.

(2) Static Electricity

The battery pack has a protection circuit. Do not use the battery where static electricity in excess of 100V is generated as it may damage the protection circuit. If the protection circuit fails, the battery may generate heat, catch fire, smoke, or explode.

(3) Charging Temperature Range

Only charge the battery between 10°C and 45°C. Charging outside of this temperature range may cause the battery to leak, generate heat, or result in serious damage. It may also cause the battery's performance and life to deteriorate.

(4) Manual

Read the manual before use. Keep for future reference.

(5) Charging Method

Read the charger's manual before use for proper charging method.

(6) First Time Usage

Please contact the supplier if the battery gives off an unusual odor, generates heat, or shows signs of rust prior to its initial use.

(7) Use by Children

Parents must explain how to use the system and the battery. Please check back periodically to ensure children are using the system and the battery correctly.

(8) Flammable Materials

Do not charge or discharge near flammable materials. Doing so could result in fire.

(9) Leakage

If electrolyte leaks from the battery and comes into contact with skin or clothing, immediately flush with water. Otherwise, it may cause skin irritation.

(10) Handling of Exposed Contacts or Conductors

If the battery pack has a system interface consisting of stripped lead wires or exposed contact plates, handle with due care. Temporarily insulate exposed contacts and conductors with an insulator such as polypropylene tape or polyvinylchloride tape. Failure to do so could result in an electrical shock; a short circuit causing the battery to generate heat, smoke, catch fire, or explode; or the combustion of other materials.

(11) Recycling

When disposing of the battery, recycle it according to local rules and regulations.

3 Scope

This specification applies to the Lithium Ion Battery NCA653864S-H00MA for Handy Terminal.

This Specification shall not apply to special applications requiring a high degree of quality and reliability where the failure or malfunction of the products may directly jeopardize life or cause threat of personal injury. A non-exhaustive list of such applications includes: weapons, aircraft and aerospace equipment, aircraft electronics equipment, medical equipment (excluding Class 1 equipment), intrinsically safe equipment, electric vehicles, hybrid electric vehicles, and electric motorcycles (excluding electric bicycles).

4 Battery Classification and Product Code

4.1 Battery Classification	Lithium Ion Battery
4.2 Product Code	BJ-F900009AA
4.3 Model Name	NCA653864S-H00MA
4.4 Cell Type	NCA653864SA

5 Nominal Specifications

Item		Specifications	Notes
5.1 Rated Capacity		2280mAh	0.456A discharge at 20°C
5.2 Capacity (Minimum)		2330mAh	0.466A discharge at 25°C
5.3 Capacity (Typical)		2400mAh	Reference only
5.4 Nominal Voltage		3.6V	0.466A discharge
5.5 Discharging End Voltage		2.75V	
5.6 Charging Current (Std.)		1.631A	
5.7 Charging Voltage		4.20 ± 0.03V	
5.8 Charging Time (Std.)		4.0 hours	
5.9 Continuous Discharge Current (Max.) *1		4.66A	0 ~ +40°C
5.10 Internal Resistance		less than 100mΩ	AC impedance 1 kHz
5.11 Weight		less than 37.3g	
5.12 Operating Temperature	Charge	+10 ~ +45°C	Standard temperature range
	Discharge	-20 ~ +60°C	
5.13 Storage Conditions (Shipping Charge State)	less than 1 month	-20 ~ +50°C	Recoverable Capacity: 80% *2
	less than 3 months	-20 ~ + 40°C	
	less than 1 year	-20 ~ + 20°C	

*1 The maximum discharge current for a single cell use. However after the battery pack assembly , maximum discharge current will be limited by a protection circuit or device.

*2 $Recoverable\ Capacity = \frac{Discharge\ Time\ after\ Storage}{Initial\ Discharge\ Time} * 100$

The discharge time is measured by fully charging the battery at 25°C and then discharging it at a current of 0.466A to 2.75V per cell in series.

6 Electrical Characteristics

Item		Conditions	Criteria
6.1	Full Charge	The battery is charged at a 1.631A constant current until the voltage reaches 4.20V. The current is then reduced to keep a constant voltage of 4.20V. The total charging time is 4.0 hours at 25°C.	
6.2	Capacity	(1) Within 1 hour after fully charging at 25°C as per item 6.1, the battery is discharged at 0.466A continuously to 2.75V at 25°C.	More than 300 min.
		(2) Within 1 hour after fully charging at 25°C as per item 6.1, the battery is discharged at 2.33A continuously to 2.75V at 25°C.	More than 54 min.
6.3	Cycle Life	After the battery has been subjected to 500 repeated charge and discharge cycles (charged by CC-CV of 1.631A – 4.20V for 4.0 hours; discharged by CC of 2.33A to 2.75V at 25°C), the discharge time is measured as per Item 6.2, (2).	More than 32 min.
6.4	Temperature Characteristics	(1) Within 1 hour after fully charging at 25°C as per item 6.1, the battery is stored at 0°C for 3 hours. The discharge time is then measured as per Item 6.2, (2) at 0°C.	More than 30 min.
		(2) Within 1 hour after fully charging at 25°C as per item 6.1, the battery is stored at 60°C for 3 hours. The discharge time is then measured as per Item 6.2, (2) at 60°C.	More than 50 min.
6.5	Storage at Fully Charged State	After fully charging at 25°C per item 6.1, the battery is stored for 20 days at 60°C After storage, the battery is held at 25°C for 3 hours. Then, the discharge time is measured as per Item 6.2, (2).	More than 30 min.
		Then, the same battery is fully charged again and discharged a second time and measured as per Item 6.2, (2).	More than 40 min.
6.6	Storage at Full Discharged State	After fully charging at 25°C, the battery is discharged as per Item 6.2, (2). Then, the battery is stored for 20 days at 60°C. After storage, the battery is held at 25°C for 3 hours. Then, the discharge time is measured as per Item 6.2, (2).	More than 50 min.

Item	Conditions	Criteria
6.7 Drop	After fully charging at 25°C, the cell is dropped 3 times in random directions from a height of 1 m onto a flat surface of concrete.	No rupture, no fire

STANDARD TEST CONDITIONS:

All tests shall be conducted with new batteries delivered within the last 7 days. Tests shall be performed at a temperature of 25±2°C and a humidity of 65±20% (the standard temperature tolerance for Class 2 and the standard humidity tolerance for Class 20, respectively, as specified by *JIS Z 8703, Standard Atmospheric Conditions for Testing*). The precision of the voltmeter and ammeter used in the tests shall be higher than Class 0.5 as specified by *JIS C 1102-2, Special Requirements for Ammeters and Voltmeters*.

7 Design and Dimensions

The battery design is shown in the following documents or drawings.

- Drawing number NCA653864S-H00MA01-0A

8 Appearance

There shall be no such defects as followings, which may adversely affect commercial value of the cell:

- Scratch
- Rust
- Discoloration
- Dirt
- Deformation
- Leakage

9 State of Charge at Time of Shipment

At time of shipment, the battery's state of charge shall be 30% of its rated capacity or less.

10 Standard Charging Method

The standard charge condition is a constant current – constant voltage method with a current of 1.631A and a maximum voltage of 4.20V. The charging process should be halted when either time, battery voltage, or current reach certain values.

When the battery is in a state of over-discharge (the battery voltage is less than 2.0V per cell), the battery should be charged by the pre-charge circuit to prevent heat generation in the charge FETs.

The pre-charging current should be approximately 0.233A. Once, the battery voltage reaches more than 2.75V per cell, the charger can resume the standard charging method. The pre-charge function should have a cut-off timer in order to detect a short circuit. If the voltage does not recover to over 2.75V per cell within the specified time, charging must be terminated.

Under normal usage the cell may swell due to advanced cycle count, continuous charging, or extended use under high temperature. Please consult SANYO for instruction on the charge method.

11 Precautions for Designing of the Handy Terminals, the Chargers and the Battery packs.

Please comply with the following instructions during every stage of application, charger, battery pack design and assembly processes otherwise the battery may experience a deterioration of functionality, quality, and safety. In the worst case, the battery may generate heat, smoke, catch fire, or explode.

11.1 Precautions for Designing of Handy Terminal and the Charger.

(1) Charge

- The battery is charged by a method of constant current-constant voltage.
- Regarding NCA653864S-H00MA, the charging current should not exceed 1.631A/cell.
- The charging voltage should not exceed 4.20V/cell.
- The charging voltage is required to be set to less than 4.23V/cell with considering the accuracy of charger. Even if the charger is failed, the total safety shall be secured.
- The charger shall be equipped with a pre-charge system.
- If battery voltage goes down to less than 2.75V/cell, the battery should be charged by pre-charge current of maximum 0.233A. Once, the battery reached more than 2.75V/cell by the pre-charging, the charger can resume the standard charging method. However, if the battery voltage never recovers more than 2.75V/cell, the charger must be stopped and turned off.
- The charger shall be equipped a full charge detection.
- The charger shall detect the full-charged state by a timer, current detection or open circuit voltage detection. When the charger detects the full-charge, the charger shall stop charging. Do not apply the continuous charging (trickle charging) method.
- The charging temperature should be confined to the range +10°C to +45°C.
- It is recommended that charging should be stopped to avoid continuous charging, when either of the following conditions are met;
  - The charging current reaches approximately 46mA in CV mode.
  - The charging time reaches 4h in case of charging at 1.631A.

(2) Discharge
- The discharge current should not exceed 4.66A/cell.
- The discharge temperature should be between -20°C to +60°C.
- The discharge end voltage should be more than 2.75V/cell.
  If cells are to be connected in series, please refer to Item 13-1.

(3) Over discharge
- Do not discharge the battery less than 2.0V/cell.

(4) Design of Handy Terminals and chargers.
- The cells should be kept away from heat generating electronic parts in order to avoid deterioration of battery performance.

(5) Strength of the battery pack enclosure
- The battery pack enclosure must be designed to have sufficient strength to resist damage from specified or typical expected mechanical stresses such as bending, twisting, and impact due to drop of application.

11.2 Precautions for Battery Pack Design.

(1) Shape, mechanism and material of battery packs
- The battery pack should be designed so it cannot connect to unauthorized chargers.
- The battery pack should be designed so it cannot connect with unauthorized equipment and/or devices.
- The terminal shape should be designed to avoid short circuit issues. In addition, the battery pack should be equipped with an over current protection function in order to prevent from external short circuit issues.
- The terminal shape and structure should be designed so that it cannot connect in backwards.
- The battery pack should be designed to prevent static electricity, electrolyte, or water ingress issues.
- The battery pack should be designed so the protection circuit functions can be inspected during the assembly process.
- The battery pack should be designed so electrolyte cannot reach to the protection circuit board even if electrolyte leak out of the cells.
- The cells should be fixed by tape or glue in the case. If the battery pack is dropped, the cells should be protected against dents, deformations, and other mechanical stresses.
- Do not apply heat, pressure, shock or any other damaging elements to the gas release vent area. SANYO will not take any responsibilities for defects of cell performance or troubles caused by them.
- Plastic cases should be closed with glue. If an ultra sonic welding method is applied to the case sealing, SANYO will not accept any responsibilities for any defects.
- The pack shall be designed so end users cannot remove or disassemble the cells.
- Protection devices (For example: PTC or a thermal fuse) shall be equipped on every cell in the appropriate area of the cell where temperature can be detected accurately. A wrong setting will result in defects and issues.
- The battery compartment should be designed to accommodate swelling of the battery after repeated cycling.

(2) Protection circuit

The following protection circuit should be equipped in the battery pack:

- **Overcharge protection**

  We recommend the overcharge protection engages when cell voltage reaches more than 4.25V/cell then, the current shall be shut down.

- **Over discharge protection**

  If cell voltage reaches approximately 2.2V/cell, we recommend that the over discharge protection circuit shuts down the discharge current and the circuit consumption current is set to less than 1μA.

- **Over current protection**

  If discharge current exceeds approximately 4.66A/cell, the over current protection will shut down the current.

(3) Electric circuit

- To avoid over discharge mode during long storage times, the consumption current of the battery pack's protection circuit should be set as low as possible.

(4) Cell connection

- The cells should not be connected using a soldering process. In order to avoid any damages, cells should be connected to lead plates by a spot welding method.

(5) Precautions on label

- The rating label should indicate required information and precautions.
- The precautions should be based on the information in section 2.

12 Storing Condition

12.1 Storage Temperature and Humidity (Within 3 months)

- Cells should be stored in a stable environment characterized by low-humidity (less than 70%RH), free of corrosive gasses, and an ambient temperature between -20℃ and +40℃.
- To prevent rust, avoid conditions that can create condensation such as rapid fluctuations in the ambient.

12.2 Long Duration Storage

- When long duration storage cells should be stored in a stable environment characterized by low-humidity (less than 70%RH), free of corrosive gasses, and an ambient temperature between -20℃ and +20℃.
- To prevent rust, avoid conditions that can create condensation such as rapid fluctuations in the ambient.
- For long term storage, a discharged or partial charged state of charge per section 9 is recommended.

13 Handling Precautions for Lithium Ion Cells

- This section describes handling precautions for lithium ion cells which will be assembled as battery packs. This battery pack consists of NCA653864SA.

13.1 Series Connections Precautions

- When cells are connected in series, make sure that the lot number, shipping charge date, and capacity rank match. Please do not mix cells with different lot numbers, shipping charge dates, or capacity ranks. The voltage variability between cells should be within 20mV.
- The lot number, the shipping charge date and the capacity rank are indicated on the shipping carton label.
- If cells are connected in series, the discharge end voltage should be set more than 3.0V/cell.

13.2 Cell Terminal Precautions

- Do not apply excessive stress to the cell terminals. It may cause a leakage or short-circuit.

13.3 Inspection of the Battery Pack before Shipping

All battery packs shall be inspected for:

- Voltage
- Internal impedance
- Function of protection circuit
- Thermistor resistance
- Thermal fuse

13.4 Precautions on Pack Assembly

- Do not use potentially abnormal cells which have been dropped, shorted, or deformed during handling or assembly even if no damage is readily apparent. Do not use cells giving off the odor of electrolyte.
- Do not bring battery near or into contact with heat sources such as soldering irons.
- Do not allow any metal to come into direct contact with pouch cells inside the battery pack compartment.
- Do not lift the core pack by holding the lead wires or the printed circuited board.
  Do not unnecessarily twist or bend the lead wires or the printed circuited board.
- Do not re-work the battery.

13.5 Swelling for Prismatic Cells

Prismatic type batteries swell with use. The value described in the drawing is the thickness after 500 cycles (Please refer to section 6.3). Therefore, when the battery is subjected to the following conditions, the degree of swelling may exceed the tolerance indicated on the cell drawing.

- Applying a charge voltage in excess of 4.20V.
- The ambient temperate of usage is not 25±2°C.
- Subjecting the battery to more than 500 charge and discharge cycles.
- Allowing the battery to sit without use for an extended period of time under over-discharged state.
- Repeatedly charging the battery while it is charged to full or nearly full.

14 Warranty Exemptions

- SANYO will not be liable for any damages that are caused by violations of the precautions in this specification.
- SANYO will not be liable for any problems caused by design defects of the battery packs, Handy Terminals, or chargers.
- SANYO will not accept return of any abnormal cells that were damaged due to any incorrect assembly process.

15 Other Remarks

- If there are problems in this specification, SANYO will take them into consideration.
- SANYO can discuss specification or precautions that are not described in this specification.
- Do not use the provided cells for other applications.

16 Battery Warranty Period

In the event a defect is found in the battery, SANYO will replace the defective battery without cost only if all the following conditions are met:

(i) The defect is found and reported to SANYO within one (1) year from the date of shipment of the defective battery;

(ii) The defect is caused by the reasons attributable to SANYO, such as a defect in design or manufacture; and

(iii) It is clear that the defect is not caused by the reasons attributable to any third party other than SANYO, such as any misuse of the battery or failure to comply with this specification.

No other warranty is implied or applied.

17 Battery Safety Requirements

In order to ensure the safety of the battery, please contact SANYO to discuss design of the application from a mechanical and electrical perspective. Also, if there are special usage conditions (for example: a large current load, a quick charge method, or a special usage pattern), please consult SANYO before finalizing the product specification.

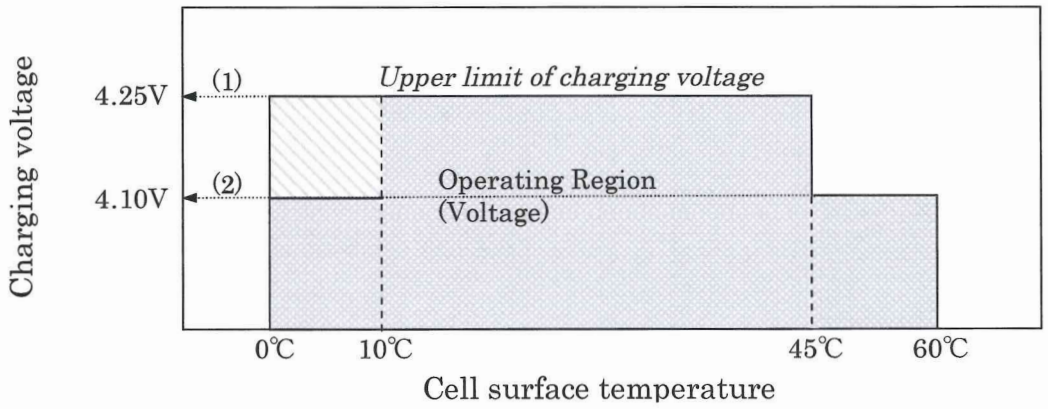
Appendix

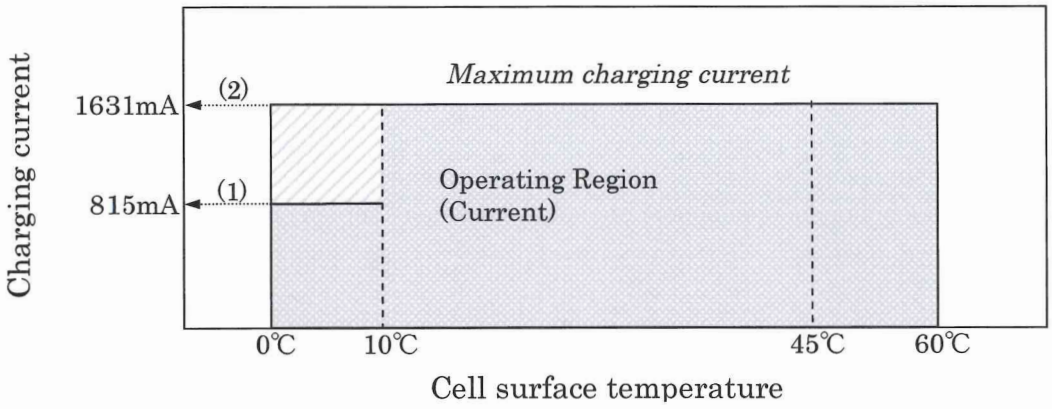
Regarding Safety Operating Region, please follow the below condition.

Model: [NCA653864S-H00MA]

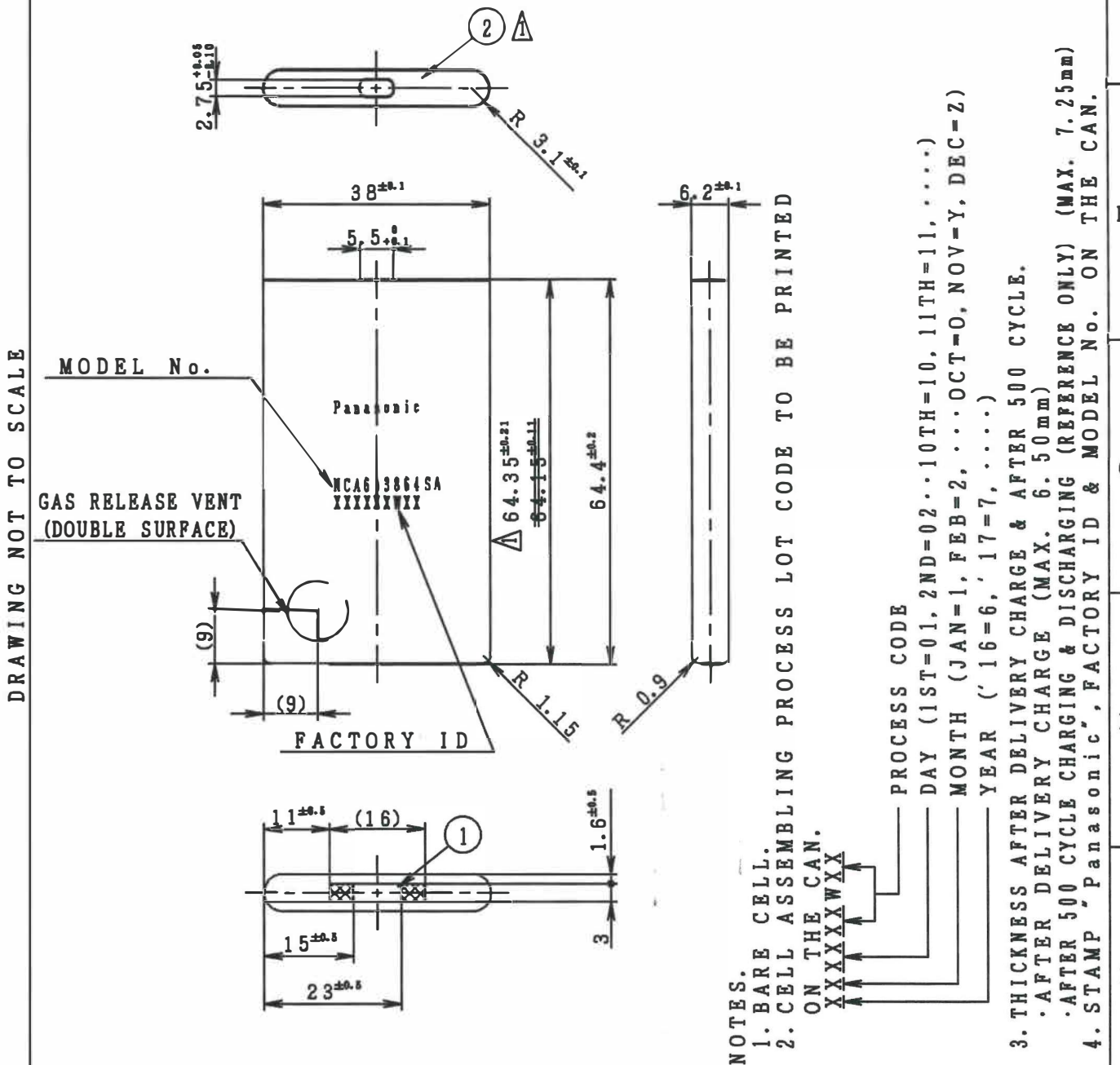
Table.1 Operating region (Cell surface temperature, voltage, current)

Temperature		Upper limit of charging voltage	Maximum charging current
0℃~10℃	(1)	4.25 V	815 mA
	(2)	4.10 V	1631 mA
10℃~45℃		4.25 V	1631 mA
45℃~60℃		4.10 V	1631 mA





NO.	PART NAME	APPLICATION·PART CODE	QTY.	MATERIAL·SPECIFICATION	NOTE
	BATTERY		1	NCA653864SA	SHIPPING WITH CHARGE
1	LEAD PLATE		1	ALUMINUM NICKEL CLAD	
⚠1 2	INSULATION RING		1	NOMEX (5MILS)	



DATE	REMARK	SYM	DATE	DESCRIPTION
JUN. 10. 2016		⚠1	JUN. 10. 2016	ADDED INSULATION RING & CHANGED DIMENSION.
D R K. Yoshimoto		⚠0	MAY. 10. 2016	1st DRAWING (K. Yoshimoto)
CHK	MODEL:NCA653864S-H00MA		材料・重量	
CHK	CUSTOMER CODE:,		MATERIAL	
ENG	TOLERANCE / WEIGHT Approx. g		処理・加工	
APP A. Komiyama	UNIT mm		FINISH	
	QTY 1 / SCALE 1/1		製品名	完成電池
			PART NAME	BATTERY PACK (finish goods)
			PART CODE	Rev.
			DRAWING NO	NCA653864S-H00MA01 0A

Sanyo Electric Co., Ltd. Rechargeable Battery Business Division A4